

Seattle Services

Part of a multi-department series on applying for City services

Design Guidelines for Public Storm Drain Facilities

Revised June 2012

This guideline explains the standard criteria to be used by civil engineers for the design of public Pipe Storm Drain (PSD), Detention Pipe, shallow street culvert, Catch Basin (CB) and Inlet facilities. These guidelines are general and may be modified by Seattle Public Utilities (SPU), as required. All drainage improvements in the right-of-way require approval by SPU.

These guidelines do not address stormwater code requirements for flow control, stormwater treatment, or green stormwater infrastructure. Regulation of groundwater is also not addressed. For requirements, see the Department of Planning and Development (DPD) web site on Stormwater Code and related Director's Rules.

<http://www.seattle.gov/dpd/Codes/StormwaterCode/Overview/default.asp>

Determine the Point of Discharge

1. Discharge to the public storm drain system is preferred over discharge to the combined sewer. Direct pipe connections are preferred over curb or gutter discharge. Early consultation with SPU is advised for determination of the point of discharge.

Grade Roadways and Alleys to Collect Drainage

2. **Grade curb returns** at a minimum 0.5% slope in the flow line and so that any low point is not in the marked or unmarked crosswalk, or in front of a curb ramp.

3. **Grade right-of-way behind the curb** to the street. Standard cross section is 2% slope to the curb per Standard Plan 400. When SPU agrees that the standard cross section is not feasible, especially at curb bulbs and bus bulbs, typical design considerations/ exceptions include:

- Drainage must be directed away from building entrances.
- The overflow scenario shall always be directed towards the street.
- Evaluate alternative curb heights down to 4-inch minimum.
- Evaluate alternative slopes on the sidewalk down to 1% minimum.
- Use the existing curb line along the walk as a depression line to drain off water to the street.
- Grade bioretention overflow to overtop the curb towards the street.
- Direct drainage to bioretention, planting strips and tree pits.

4. **Grade new curb bulbs** to minimize extensions of the public storm drain. Locate low points to allow access for maintenance of drainage structures when vehicles are parked, to the extent feasible. Survey the roadway cross section at curb bulbs and identify crown location and surface topography impacts to flow line.



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5. Flow that has been concentrated along a gutter or flow line shall be collected in a drainage structure, not left to fan out and disperse.
6. Set elevations for inlets and CB grates, at face of curb, to include the drainage transition zone as shown in Standard Plan 260.
7. **Grade alleys** to drain to the perpendicular street. Low points and extensions of the public storm drain to mid-alley low points will not be permitted, except when SPU agrees that there is no feasible alternative. When considered:
 - Provide safe truck access and without backing up.
 - Protect property, assuming clogged CBs will not be functioning or maintained during storms.

Locating Catch Basins and Inlets

8. Drainage shall be collected at all closed contour low points and minor low points along the roadway, upstream of all intersections and crosswalks, prior to transitions on superelevated roads, and at the downstream end of developed alleys upstream of the sidewalk. Considerations include:
 - A variance may be allowed, when the distance from a high point to the intersection, crosswalk, or end of an alley is less than 100 feet.
 - Additional drainage pickups (CBs) will be required at closed contour low points.
 - Additional drainage pickups may be required to limit clogging from tree leaves.
 - Additional drainage pickups may be required at abrupt grade changes.
9. Arterial streets with a grade flatter than 1.0% shall have catch basins every 350 feet, minimum.
10. Water from no more than 1,000 total lineal feet of curb may discharge into one catch basin. This includes the length of curb for inlets which discharge into a catch basin as well as the catch basin itself.

11. **Open grates** shall not be located in any crosswalk or in front of curb ramps. From a curb ramp landing to any grate, the minimum clear distance is 1 foot.

12. Locate and relocate solid cover CBs to avoid the pedestrian and bicycle access routes, stay close to the curb to limit lane closures during maintenance and avoid the vehicle wheel path to limit noise and wear.

13. For standard locations see Standard Plan 260. Typical exceptions to locating structures 1 ½ feet from the PC or PT include:

- A wider crosswalk or curb ramp location that would direct pedestrians to cross a grate.
- Grading results in a low point further up gradient.
- Utility conflicts can be avoided by moving the structure up-gradient.
- To pick up flow collected along a curb prior to grade flattening at the intersection, especially at curb bulbs.

14. Consider that maintenance of drainage structures can be a hazard to tree health. To the extent feasible, locate structures outside the full growth drip line of street trees. Minimum distance from the trunk is 5 feet.

15. **Gutter flow calculations** evaluating depth and spread of peak flows and grading of the street network beyond the project area may be required for locating drainage pickups on arterial streets.

What Type of Catch Basin or Inlet to Use Where

16. CBs provide more reliable drainage pickup and are preferred over inlets. Typical exceptions where inlets are installed, include:
- When the existing condition is an inlet and CB system. See Detail 1.
 - When utility interferences prevent installing a CB along the curb line. See Detail 2.

17. Inlets along new curbs must conform to Standard Plan 250, or be replaced. Whenever an inlet is replaced the connection pipe to the CB must be replaced with new pipe. If the existing CB or CB connection pipe is determined to be defective by SPU, it must also be replaced.

18. **Standard CB installation** within the street shall be per Standard Plan 242B or 240D, which have a vane grate and through curb opening. Typical design considerations/ exceptions include:

- Type 242B to allow for locating other shallow utilities behind the curb.
- Type 242B to avoid a top slab within the pavement
- Type 240A when inlets provide the open grated surface and the CB has a solid lid.
- Type 240D when a higher outlet pipe is needed.
- Type 240D if an inlet will be connected to the grated CB, since it has a straight barrel section for a cored hole.
- Type 242A, or 240C, that do not have a through curb opening, when the structure is not at a curb or curb height is less than 4-inches.

19. **Standard Inlet installation** within the street shall be per Standard Plan 250B, which has a vane grate and through curb opening. Type 250A should be used when the structure is not at a curb or curb height is less than 4-inches.

20. **For curb bulbs**, see Detail 4. Locate a Standard Plan type 242B CB no further up gradient than 1 ½ feet from the PC or PT of the curb bulb. A Standard Plan 250B Inlet may be used when the existing condition is an inlet and CB system and:

- The location is not a closed contour low point or a minor low point.
- The inlet connection pipe can be placed at a minimum slope of 5% with an invert at the CB above the outlet pipe invert.
- Either an existing CB in good condition or a new type 240A CB is located in the roadway.

21. **At closed contour low points**, where plugging of the catch basin or inlet could result in street flooding, overtopping of the curb and/or private property damage two independently connected CBs are required. At most locations, the second CB may be on the opposite side of the street. See Detail 3.

22. **In alleys**, use a Standard Plan 241 catch basin.

23. **For all elevated structures**, consult with SPU early about requirements. If drains are required on a bridge, drains shall be per Standard Plan 290 with a grate per Standard Plan 265. New bridge downspouts shall have a minimum pipe diameter of 6-inches and a minimum bend radius of 4-feet.

24. **For non-standard installations within the shallow ditch and culvert system**, consult with SPU early about requirements. Typical design considerations/exceptions include:

- The City does not generally permit the filling of a ditch if that ditch functions as part of the City's informal drainage system in the street right-of-way and is located within a creek watershed.
- Replace all existing sand boxes within the project area with either a CB or a junction box, depending on the function.
- Grade and define depression lines to reduce the number of structures needed.
- CB to CB connections along the culvert. This avoids offset CBs that would require a junction box because a tee connection to the existing shallow culvert is not feasible.
- Eliminating the trap when connecting CB to CB.
- Type 241 CB with a vane grate within the roadway.
- Reduced or eliminated riser sections, if the street surface is flat enough to allow for adjustment of the casting with less riser.
- Inverted frames to reduce the height of the casting.
- Situation specific designs of shallow structures.

25. Other non-standard installations and modified structures may be approved, if SPU agrees that grading to eliminate the need is not feasible. Structures will be individually reviewed, using the following criteria:

- The non-standard structure is accessible and maintainable.
- The non-standard structure does not increase risk of flooding.
- The non-standard structure is ADA compliant.
- Within the roadway, consider, in the following order:
 - 1) Use of a smaller standard structure (ex. Type 241 with vane grate).
 - 2) A modified shallower CB that has a standard grate, the maximum sump possible and a trap. Detail required.
- Behind the curb installations will be evaluated in the following order:
 - 1) Depression line to an inlet, which is connected to existing CB.
 - 2) Depression line to CB and connection to main.
 - 3) Trench grate will only be approved if there is no infrastructure available for CB connection.

Inlet and CB Connecting Pipes

26. Sizing. Inlet connection and CB connection pipe standard size is 8-inch diameter. Typical exceptions include:

- When the CB is being connected to a 8-inch combined sewer, use a 6-inch diameter pipe.
- A variance may be allowed to reconnect to an existing 6-inch connection pipe in good condition, rather than replacing all the way to the mainline. Use a 6-inch diameter pipe and a shielded flexible coupling. Connecting new 8-inch pipe to an existing 6-inch pipe will not be allowed.
- Use 6-inch pipe when collecting sidewalk drainage only.

27. Inlet connections shall be straight, placed at a minimum slope of 5%, a maximum length of 50 feet and, with the invert at the CB above the outlet pipe invert. Inlets must connect to a CB. Direct connection to a mainline will not be permitted.

28. See Standard Plans 242, 250 and 261 for allowable location and orientation of outlets from structures. Pipe shall be oriented to allow tool access utilizing the length of the casting opening and traps shall be below the casting, so they can be reached.

29. CB connections shall be placed at a minimum slope of 2% and a maximum of 100% slope. Bends are expected, but shall not exceed 22½° in a single fitting. A straight pipe section of 1 foot minimum is required between fittings.

30. Pipe material will be ductile iron (DIP). See standard construction notes "[Drainage CB and Inlet Notes](#)" and Standard Specifications.

Typical exceptions:

- When site conditions include corrosive soils or other corrosion source, use a non-metallic pipe.
- When coupling to an existing pipe to remain, evaluate matching the existing pipe material.

31. Connections to new mainline pipe shall be by manufactured tee unless the new mainline is 24-inch or greater, or the new mainline is reinforced concrete pipe (RCP). For information on allowable connections and procedures for connections to existing mainline see [SPU Core Tap Procedures](#). Connections to maintenance holes are non-standard and will be evaluated by SPU case-by-case.

32. Connections to shallow street culverts shall be by junction box when it is not feasible to install a tee on the existing culvert above springline.

33. Connections to a ditch shall be tapered to match the ditch grading and armoring to prevent erosion may be required.

34. Plan submittal requirements:

- Station and offset to staking point at face of curb.
- Profiles are not required for inlet or CB connection pipe, except to show known conflicts or non-standard laying conditions, or connections to mainlines. The standards allow for some field adjustment. However, checking for clearances from other utilities is advised.

Mainlines- Pipe Storm Drains (PSD)

35. Locate storm drains in the standard location, seven feet south or west of the right-of-way centerline, as shown in Standard Plan 030. Alternate alignments require the approval of both SPU and SDOT.

36. Sizing. Storm drains shall be designed for full gravity peak flow with a 4% annual probability (25-year recurrence). The hydraulic grade line (HGL) for that peak flow must stay a minimum 4 feet below the rim of all drainage structures and a minimum 3 feet below the lowest elevation served by gravity on adjacent private properties. For more information on requirements for hydrologic analysis, including tidal and lake backwater constraints, see Chapter 6, Hydrologic Analysis and Design, of the Stormwater Flow Control and Water Quality Treatment Technical Requirements Manual. <http://www.seattle.gov/dpd/codes/dr/DR2009-17.pdf>

37. PSDs shall be a minimum of 12-inch diameter.

38. Pipe slope shall generally follow the surface topography at a standard depth of cover of 6-feet. Desired minimum pipe slope is 1%.

Typical exceptions include:

- Downstream system is deeper, or shallower than 6 feet.
- Surface topography is flat and pipe slope is 0.5%.
- Connection cannot be made unless pipe slope is less than 0.5%.

39. Minimum velocity required is 3 feet per second (fps). If velocity exceeds 20 fps, energy dissipation is required to minimize hydraulic jumps.

40. Pipe material will be as approved by SPU, most typically DIP or RCP. See standard construction notes “[Mainline Conveyance and Detention Notes](#)” and Standard Specifications.

41. Plan submittal requirements:

- Pipeline profiles. Invert elevations at MHs shall be calculated and shown by projecting pipe slopes to the center of the structure.
- HGL shown on the profile, if the pipe is surcharged.
- Notes documenting major hydrologic and hydraulic design assumptions.
- A drainage report documenting all calculations.

Maintenance Holes (MH)

42. MHs are required at intersecting streets for future extensions, every 375 feet, at pipe ends, at pipe junctions, grade breaks, or changes in horizontal alignment. Typical exceptions include:

- Connection is to a very large diameter storm drain and a MH can be set on the smaller pipe within 30 feet of the connection.
- A MH may not be required at an end of pipe that is less than 100 feet in length, especially if a future extension is anticipated.
- A MH may not be required for a single vertical or single horizontal bend no greater than 22½° between MHs.
- If the MH spacing requirement results in a MH located where access would be difficult.

43. Crowns of pipe shall match at MHs. For details on MHs, see the [Standard Plans](#) 204 through 212. For standard installations, use Type A unless the pipeline is too shallow.

44. **Drop connections** may be approved when SPU agrees that slope or depth makes matching crowns not feasible. For inside drop connections, see Standard Plan 233b.

45. For information on MH sizing, see [Maintenance Hole Selection](#).

Detention Pipe and Flow Control Structures

46. Detention shall be in a detention pipe conforming to Standard Plan 272.

47. **Locate detention** to minimize traffic impacts during maintenance. Locate off arterials, when feasible. Locate MHs to allow a single lane closure. Connect the flow control structure to a MH on the mainline. When possible, use an existing MH and rechannel.

48. **Detention pipe material** will be as approved by SPU, most typically DIP, or RCP. If pavement restoration can wait 30 days after installation for flexible pipe testing, polypropylene will be allowed. See standard construction notes "[Mainline Conveyance and Detention Notes](#)" and Standard Specifications.

49. Plan submittal requirements:

- Detention pipe profile.
- A detail of the flow control structure.
- Notes with the detail documenting the major hydrologic and hydraulic design assumptions.
- A drainage report documenting all detention calculations.

Additional Resources

Related information on permits and plan preparation, including standard construction notes for Street Improvement Permits, such as: Drainage CB and Inlet Notes; SPU Mainline and Detention Notes; Stormwater Treatment Notes; and Bioretention Notes are available at the Seattle Department of Transportation (SDOT) web site.

http://www.seattle.gov/transportation/stuse_sip.htm#notes

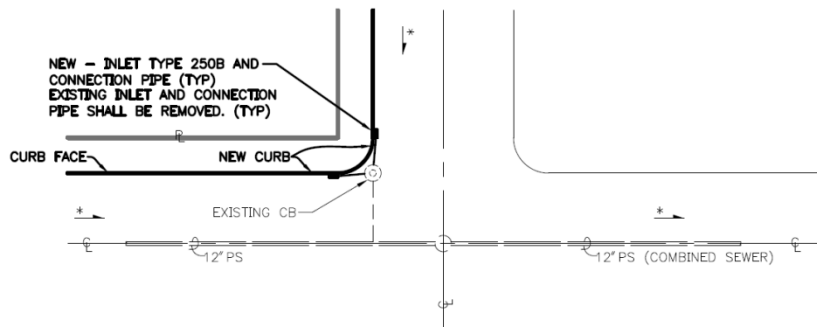
For Standard Plans of drainage system components, see the latest edition and most current amendments of the City of Seattle Standard Plans and Standard Specifications for Road, Bridge, and Municipal Construction. http://www.seattle.gov/util/Engineering/Standard_Plans_&_Specs/index.asp

For information on how to make connections to existing pipe, see the SPU Core Tap Procedures at the SPU web site.

http://www.seattle.gov/util/engineering/obtain_utility_services/drainage_&_wastewater_planning/index.asp.

For roadway design standards, including standards for green stormwater infrastructure in the right-of-way, see the SDOT web site for the Right-of-Way Improvements Manual.

<http://www.seattle.gov/transportation/rowmanual/>

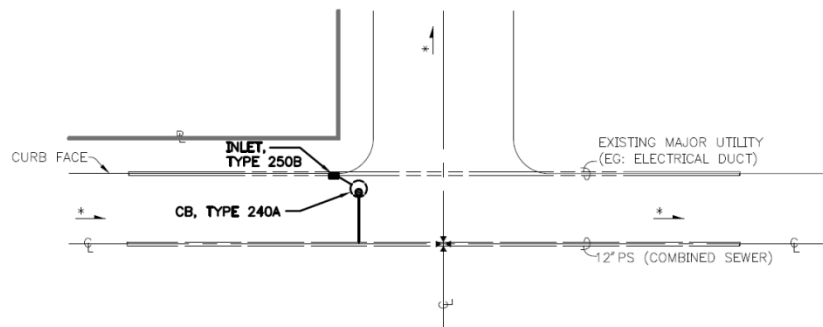
**DETAIL****INLET PLACEMENT ALONG NEW CURB**

1

NTS

NOTES: EXISTING CATCH BASIN IS NOT REQUIRED TO BE REPLACED IF IN GOOD WORKING CONDITION.

- SLOPE (TYP)

**DETAIL****INLET PLACEMENT AT UTILITY CONFLICTS**

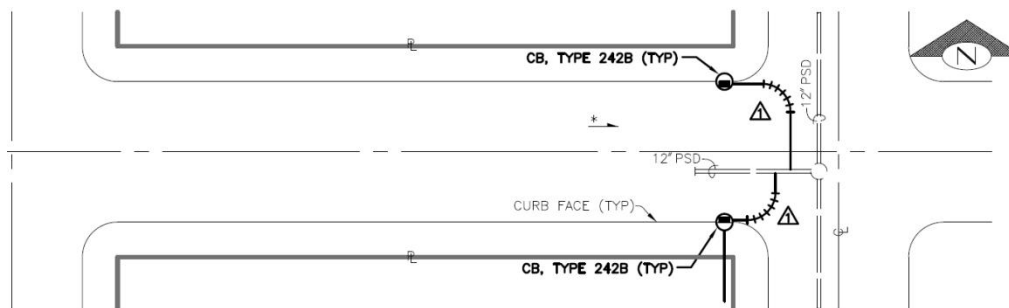
2

NTS

NOTES: TO BE USED ONLY WHEN MAJOR EXISTING UTILITIES CONFLICT STANDARD CB PLACEMENT.

NOT APPROPRIATE AT CLOSED CONTOUR LOW POINTS WHERE PLUGGING OF THE INLET COULD RESULT IN DAMAGE.

- SLOPE (TYP)

**DETAIL****CATCH BASIN LAYOUTS**

3

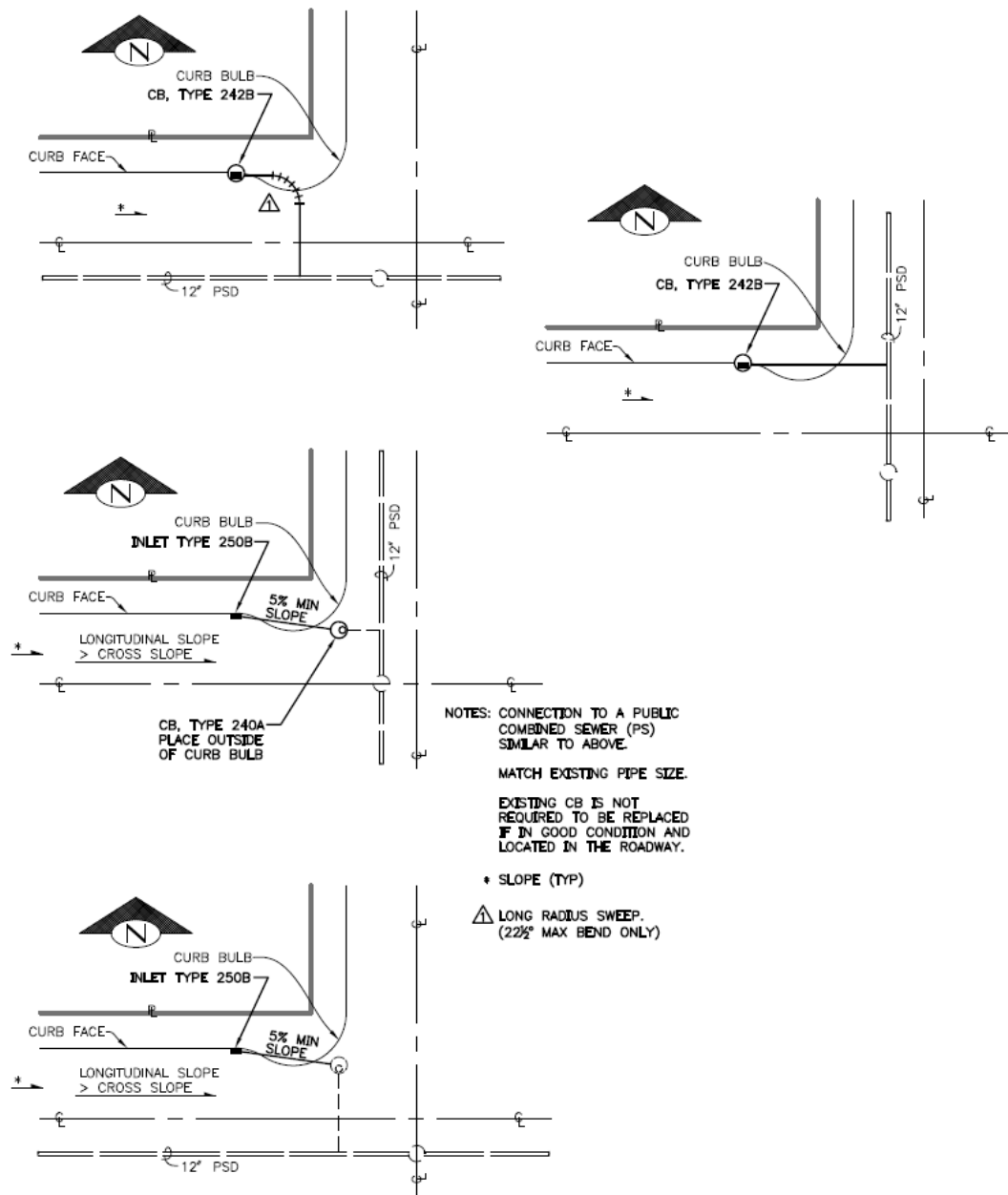
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NOTES: MEETS 2 CATCH BASINS AT CLOSED CONTOUR LOW POINT REQUIREMENT ON CROWNED STREETS.

CONNECTION TO A PUBLIC COMBINED SEWER (PS) SIMILAR TO ABOVE.

- SLOPE (TYP)

△ LONG RADIUS SWEEP. (22½° MAX BEND ONLY)



DETAIL

INLET/CATCH BASIN LAYOUT AT CURB BULBS

4

NTS